PHSX 221L **Measurement and Density** **Name:**_____

Object: (a) To practice measuring skills. (b) To determine the relationship between the circumference and the radius for six masonite disks. (c) To determine the relationship between mass and radius for six masonite disks. (d) To determine the density of the masonite from which the disks are made as well as the density of some other substances.

Theory: From geometry we know that the radius and the circumference of a circle are related by:

$$C = 2\pi r. \tag{1}$$

Thus, if C were plotted against r the graph should be linear with a slope equal to 2π.

Density, ρ, is defined as

$$\rho = \frac{m}{V} \tag{2}$$

which becomes for a disk

$$\rho = \frac{m}{\pi r^2 t} \tag{3}$$

where t is the thickness of the disk.

Solving these equations for mass we obtain:

$$m = \rho V = \rho \pi r^2 t. \tag{4}$$

Consequently, a plot of mass m versus radius r should be a parabolic curve. But, if m were plotted versus r^2 the graph should be a straight line with slope equal to $\rho\pi t$.

Procedure:

1. Measure and record the radius and circumference of each masonite disk.
2. Plot a graph of circumference versus radius from this data.
3. Measure the mass of each disk.
4. Plot a graph of mass versus the square of the radius.
5. Compute the density for each disk by formula.
6. Measure the mass and volume of a pine block, an aluminum rod (or a copper wire) and compute the densities of these solids.
7. Measure the mass and volume (a graduated cylinder would be useful) of various amounts of water. Make a plot of mass vs. volume and compute the slope of the line.

Results:

1. What is the slope of your circumference-radius graph? How does this value compare with the theoretical prediction?
2. Does your mass-radius squared graph appear linear? If so, what is the slope?
3. Use the slope of your mass-radius squared graph to compute the density of masonite.
4. Compute the average density of all the disks found in step 5 of the procedure.
5. How does this average density compare with the density as computed from the slope of the mass-radius squared graph?
6. How do your measured densities for pine, aluminum (or copper), and water compare with accepted values?

Questions:

1. What could affect or change the density of a substance?

2. How could you measure the density of irregularly shaped objects?

Conclusions: What was the main purpose of this lab? What did you learn from this lab? How big were the errors? What were the various sources of error? What clever things did you do to reduce error as much as possible? Did you like the lab? What will you remember in 3 months about this lab?